DOCUMENT RESUME

ED 319 612 SE 051 424

AUTHOR Hall, Donald A.

TITLE The Effects of an Innovative Activity-Centered Biology Program on Attitude toward Elementary Teachers.

PUB DATE 90

NOTE 14p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (63rd, Atlanta, GA, April 8-11, 1990).

PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Biology; Classroom Environment; *College Science; Elementary Education; *Elementary School Science; Experiential Learning; Higher Education; *Preservice Teacher Education; Science Education; *Science Instruction; *Student Attitudes; Teaching Methods

ABSTRACT

One of the primary goals in many teacher education programs is to design and to implement specific courses, strategies, and methods that promote positive attitude toward science and science teaching among elementary education majors. This paper describes the effects of a biology content course, patterned after innovative elementary school science programs, on attitude toward science teaching among prospective elementary teachers. Attitude was measured using the Revised Science Attitude Scale pretest-postest. Subjects were 159 students enrolled in a biology content course designed specifically for prospective elementary teachers. There were significant positive differences in attitude toward science teaching pre-test-post-test following 10 weeks of instruction. It was suggested that factors such as inadequate science background, lack of specific training, high science anxiety, and failure to understand the nature of science could have contributed to any negative feelings toward science teaching. Positive feelings could have been generated by the program itself, by employing specific strategies emphasizing concrete examples and live materials, and by promoting built-in opportunities for student success. In addition, classroom climate (including small-group activities, social interaction, and positive student-teacher relationships) could have contributed to favorable attitude toward science teaching. (CW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED319612

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Donald A. Hall

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

THE EFFECTS OF AN INNOVATIVE ACTIVITY-CENTERED BIOLOGY PROGRAM ON ATTITUDE TOWARD ELEMENTARY TEACHERS

Donald A. Hall

Department of Biological Sciences
St. Cloud State University
St. Cloud, MN 56301

Paper presented at the annual meeting of the National Association for Research in Science Teaching, Atlanta, GA, April, 1990.

SE051424

BEST COPY AVAILABLE

THE EFFECTS OF AN INNOVATIVE ACTIVITY-CENTERED BIOLOGY PROGRAM ON ATTITUDE TOWARD SCIENCE TEACHING AMONG PRESERVICE ELEMENTARY TEACHERS

Abstract

This study investigated the effects of an innovative activity-centered biology program on attitude toward science teaching among preservice elementary teachers. Subjects were 159 students enrolled in a biology content course designed specifically for prospective elementary teachers. Pretest and posttest measures were taken from scores using the Revised Science Attitude Scale.

There were significant positive differences in attitude toward science teaching ($p<.001$) pretest-posttest following 10 weeks of instruction. In general, subjects in this study thought science processes were important in the elementary classroom, thought teaching science does not take too much time or effort, thought they would not dread teaching science, hoped to be able to excite their students about science, thought children were curious about scientific matters, and thought they would enjoy the laboratory component of the science courses they teach.

It was suggested that factors such as inadequate science background, lack of specific training, high science anxiety, and failure to understand the nature of science could have contributed to any negative feelings toward science teaching. Positive feelings could have been generated by the nature of the program itself, by employing specific strategies emphasizing concrete examples and live materials, and by providing built-in opportunities

for student success. In addition, classroom climate (including small-group activities, social interaction, and positive student-teacher relationships) could have contributed to favorable attitude toward science teaching.

The results of this study support the belief that the strategies and methods featured in the innovative science programs be incorporated into college science courses for elementary teachers. Since measuring preservice teachers' attitudes toward science and science teaching may not be adequate predictors of their actual science teaching behavior, longitudinal studies linking attitude and practice are recommended.

THE EFFECTS OF AN INNOVATIVE ACTIVITY-CENTERED BIOLOGY PROGRAM ON ATTITUDE TOWARD SCIENCE TEACHING AMONG PRESERVICE ELEMENTARY TEACHERS

Purpose

The purpose of this study was to examine the effects of an innovative activity-centered biology program on attitude toward science teaching among preservice elementary teachers. A recent survey on research priorities supported the contention that attitudes are of prime concern in science education (Abraham, Renner, Grant, & Westbrook, 1982). Furthermore, studies from the United States and several foreign countries suggest that student interest in science may account for up to 25 percent of the variation in academic achievement in science (Simpson, 1978).

And yet, despite recognition of attitudinal goal importance, science teachers apparently fail to systematically assess affective student outcomes (Hofstein, Yager, & Walberg, 1982; Schibeci, 1981). It appears that science teachers often assume that various instructional components, including laboratory activities, foster student interest and attention; hence, teachers fail to assess affective student outcomes. Moreover, there continues to be an obvious decline in science interests among many students, beginning in the intermediate grades (Yager & Yager, 1985).

Since this decline in science interests continues on through college, negative attitude toward science and science teaching, particularly among preservice elementary teachers, could have a serious and long-lasting impact on student and teacher performance. Thus, a primary goal in teacher-education programs should be to design and to implement specific courses, strategies, and methods that promote positive attitude toward science and science teaching among elementary education majors.

This paper describes the effects of a biology content course, patterned after the innovative elementary school science programs, on attitude toward science teaching among prospective elementary teachers. Attitude was measured using the Revised Science Attitude Scale (Thompson & Shrigley, 1986) pretest-posttest.

It was hypothesized that subjects participating in such a program, which featured exploration and discovery based on the learning cycle approach, would experience positive gains in attitude toward science teaching following 10 weeks of instruction.

Design and Procedures

This study was conducted during the 1989 winter and spring quarters using 159 subjects (130 females, 29 males) enrolled in a biology content course designed specifically for prospective elementary teachers. The majority of students were in their junior year, prior to taking science methods.

Course content and strategies are consistent with the innovative elementary science programs. Hence, the course is highly activity-centered with emphasis on inquiry and problem solving using hands-on, process-oriented activities which encourage social interaction in small-group settings. Teacher behavior is largely indirect with a major focus on student exploration and discovery. The primary instructional mode features the learning cycle approach.

The 22-item, Likert-type Revised Science Attitude Scale, developed specifically to measure preservice teachers' attitudes toward science teaching (Thompson & Shrigley, 1986) was employed in this study. The authors report this instrument to be reliable (coefficient alpha 0.92) and valid. Pretests and posttests were administered at the beginning and end of each quarter

respectively and group scores subjected to paired t-test analyses. In addition, responses to scale subcomponents (construction and manipulation of science equipment, need for science in the elementary school curriculum, time necessary to teach science, and comfort and ease of teaching science) were compared and analyzed, as were individual student's pretest and posttest scores. Reversal of numerical values for all negative statements provided consistency in a positive direction.

Results

Pretest and posttest descriptive data are shown in Table I. The mean pretest score on the Revised Science Attitude Scale was 84.58 out of 110 possible (SD=8.43). The mean posttest score was 89.90 (SD=8.20). This difference was statistically significant ($t = -8.78$, $p<.001$). In addition, mean scores from each of the four subcomponent categories were also significantly different in a positive direction ($p<.001$) pretest-posttest, as shown in Table II.

Table III shows scores for each of the attitude statements, pretest-posttest. Statements that generated the highest posttest group mean scores dealt with (1) enjoyment of the laboratory period ($\bar{x}=4.41$), (2) time requirements for teaching science ($\bar{x}=4.47$), (3) the importance of teaching science processes ($\bar{x}=4.51$), (4) dread of teaching science ($\bar{x}=4.53$), (5) teacher excitement of students about science ($\bar{x}=4.56$) and (6) student curiosity about scientific matters ($\bar{x}=4.65$).

Discussion

Past findings agreed that the innovative science programs were more effective in promoting positive attitude toward science among elementary and secondary students than their counterparts using a more traditional approach (Jaus, 1977; Kyle, Bonnstetter, & Gadsden, 1988; Shymansky, Kyle, & Alport, 1983). This study generated evidence that suggested a biology content course patterned after the innovative elementary school science programs

had significant positive effect on prospective elementary teachers' attitude toward science teaching. This supports the contention of Shrigley (1974) that the strategies and methods featured in these innovative science programs be incorporated into the college science courses for elementary teachers. In addition, the findings of this study agreed with prior research in that activity-oriented, process-approach instruction characterized by inquiry and discovery promoted positive attitudes among preservice elementary teachers (Kennedy, 1973; Kramer, 1979, 1988; Strawitz, 1976; Westerback, 1982).

Attitude statements that generated the most positive responses in this study suggested that subjects in general thought they would not dread teaching science, hoped to be able to excite their students about science, thought science processes were important in the elementary classroom, thought children were curious about scientific matters, did not think teaching science took too much time or effort, and thought they would enjoy the laboratory period in the science courses they teach.

It is of particular interest to compare the results of this study with the results obtained by Kramer (1979, 1988). Kramer used the original version of the Science Attitude Scale (Shrigley, 1974) in both his initial study and in his replication study. In addition, Kramer's subjects were prospective elementary teachers enrolled in the same course and in an identical setting as were the subjects described in this study. Although the original Science Attitude Scale represented two distinct attitude objects (attitude of the preservice teacher toward enrollment in science courses and attitude of preservice teachers toward the teaching of science), similar results were obtained in both this and in Kramer's studies. Succinctly, there was an overall positive attitude shift on every item pretest-posttest as well as on each subset.

As Kramer pointed out, it is of interest to speculate as to what factors or combination of factors might have affected the prospective teachers' attitude toward science teaching. While it is recognized that many uncontrolled variables exist in these descriptive studies, several factors that may have contributed to the positive attitude shift include the following.

First, the program itself featured several aspects of the innovative elementary science programs including manipulative, hands-on experiences using live materials whenever possible. The primary instructional mode was based on the learning cycle approach with emphasis on inquiry, science processes, exploration, and discovery. Hence, teacher behavior was largely indirect with the teacher acting as facilitator of learning.

Second, specific strategies, using concrete examples, were employed to clarify and to amplify the more difficult concepts such as photosynthesis, cellular respiration, and fermentation. In addition, students worked in small group settings which encouraged cooperation and social interaction. Furthermore, students used notecards on two of their three exams, thus providing built-in opportunities for success.

Finally, research indicates that classroom climate influences student attitude (Lawrenz, 1976; Simpson, 1978; Vargas-Gomez & Yager, 1987). In view of this, careful attention was focused on student-teacher interaction during this study. Qualitative data generated from student evaluations indicated the instructor exhibited enthusiasm for the subject matter as well as genuineness, empathy, care, and concern toward the students. Thus, this positive classroom environment could have promoted improved student attitudes toward science teaching.

One important implication generated from an attitude study such as this concerns the long-term effects of attitude change. As Koballa (1986) suggested, measuring preservice teachers' attitudes toward science and science teaching may not be adequate predictors of their actual science teaching behaviors. Longitudinal studies linking attitude and practice are needed.

Conclusions and Recommendations

1. A biology content course patterned after the innovative elementary science programs was significantly effective in promoting positive attitude toward science teaching among prospective elementary teachers following 10 weeks of instruction.
2. The most positive responses indicated that preservice teachers in this study:
   - thought they would not dread teaching science,
   - hoped to be able to excite their students about science,
   - thought science processes were important,
   - thought children were curious about science,
   - did not think teaching science took too much time or effort, and
   - thought they would enjoy the laboratory period in the science courses they teach.
3. More qualitative data based on student journals, interviews, tape recordings, and researcher observations are needed.
4. This study should be replicated and extended to include an experimental design format.
5. Longitudinal studies linking attitude and classroom practice are needed.

References Cited

Abraham, M. R., Renner, J. W., Grant, R. M., & Westbrook, S. L. (1982). Priorities for research in science education: A survey. Journal of Research in Science Teaching, 19, 697-704.

Hofstein, A., Yager, R. E., & Walberg, H. J. (1982). Using the science classroom learning environment for improving instruction. School Science and Mathematics, 82, 343-351.

Jaus, H. H. (1977). Activity-oriented science: Is it really that good? Science and Children, 14, 26-27.

Kennedy, T. G. (1973). The effect of process approach instruction upon changing pre-service elementary teachers' attitudes toward science. School Science and Mathematics, 73, 569-574.

Koballa, T. R., Jr., (1986). Teaching hands-on science activities: Variables that moderate attitude-behavior consistency. Journal of Research in Science Teaching, 23, 493-502.

Kramer, D. C. (1979). Science attitude change in preservice elementary teachers during an activity-oriented biology course. School Science and Mathematics, 79, 294-298.

Kramer, D. C. (1988, April). Science attitude change in preservice elementary teachers during an activity-oriented biology course: A replication study. Paper presented at the annual meeting of the Minnesota Academy of Science, Macalester College, St. Paul, Minnesota.

Kyle, W. C., Jr., Bonnstetter, R. L., & Gadsden, T., Jr. (1988). An implementation study: An analysis of elementary students' and teachers' attitudes toward science in process-approach vs. traditional science classes. Journal of Research in Science Teaching, 25, 103-120.

Lawrenz, F. (1976). Student perception of the classroom learning environment in biology, chemistry, and physics courses. Journal of Research in Science Teaching, 13, 315-323.

Schibeci, R. A. (1981). Do teachers rate science attitude objectives as highly as cognitive objectives? Journal of Research in Science Teaching, 18, 69-72.

Shrigley, R. L. (1974). The attitude of preservice teachers toward science. School Science and Mathematics, 74, 243-250.

Shrigley, R. L. (1974). The correlation of science attitude and science knowledge of preservice elementary teachers. Science Education, 58, 143-151.

Shymansky, J. A., Kyle, W. C., Jr., & Alport, J. M. (1983). The effects of new science curricula on student performance. Journal of Research in Science Teaching, 20, 387-404.

Simpson, R. D. (1978). Relating student feelings to achievement in science. In M. B. Rowe (Ed.), What research says to the science teacher (Vol. 1). National Science Teachers Association.

Strawitz, B. M. (1976, April). The effects of an activity-centered elementary education science methods course on the attitudes of preservice teachers. Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, California.

Thompson, C. L., & Shrigley, R. L. (1986). What research says: Revising the Science Attitude Scale. School Science and Mathematics, 86, 331-343.

Vargas-Gomez, R. G., & Yager, R. E. (1987). Attitude of students in exemplary programs toward their science teachers. Journal of Research in Science Teaching, 24, 87-91.

Westerback, M. E. (1982). Studies on attitude toward teaching science and anxiety about teaching science in preservice elementary teachers. Journal of Research in Science Teaching, 19, 603-616.

Yager, R. E., & Yager, S. O. (1985). Changes in perceptions of science for third, seventh, and eleventh grade students. Journal of Research in Science Teaching, 22, 347-358.

Table I

Comparison of Pretest and Posttest Scores on Attitude Toward Science Teaching Among Preservice Elementary Teachers (N=159)

Pretest $\bar{x}$	Pretest SD	Posttest $\bar{x}$	Posttest SD	t-value
84.58	8.43	89.90	8.20	-8.78*

*p<.001

Table II

Comparison of Mean Pretest and Posttest Scores for Science Attitude Scale Subcomponents* (N=159)

Subcomponent Category	Pretest $\bar{x}$	SD	Posttest $\bar{x}$	SD	t-value
I. Construction and manipulation of science equipment (5)	3.72	.49	3.99	.44	-7.80**
II. Need for science in the elementary school curriculum (5)	4.14	.40	4.30	.45	-4.43**
III. Time necessary to teach science (3)	4.19	.42	4.34	.50	-4.01**
IV. Comfort and ease of teaching science (9)	3.64	.53	3.95	.46	-7.98**

* Based on a Likert-type scale, 1-5.
** p<.001

Table III

Mean Pretest and Posttest Scores for Statements on the Revised Science Attitude Scale*

	Statement	Subcomponent**	Pretest $\bar{x}$ (N=159)	Posttest $\bar{x}$
1.	I will feel uncomfortable teaching science.***	IV	3.59	3.60
2.	The teaching of science processes is important in the elementary classroom.	II	4.22	4.51
3.	I fear that I will be unable to teach science adequately.***	IV	3.55	4.01
4.	Teaching science takes too much time.***	III	4.31	4.47
5.	I will enjoy the lab period in the science courses that I teach.	I	4.23	4.41
6.	I have a difficult time understanding science.***	IV	3.38	3.91
7.	I feel comfortable with the science content in the elementary science curriculum.	IV	3.53	3.99
8.	I would be interested in working in an experimental elementary science curriculum.	II	3.65	3.92
9.	I dread teaching science.***	IV	4.25	4.53
10.	I am not afraid to demonstrate science phenomena in the classroom.	I	3.57	3.82
11.	I am not looking forward to teaching science in my elementary classroom.***	IV	4.02	4.18
12.	I will enjoy helping students construct science equipment.	I	3.96	4.14
13.	I am willing to spend time setting up equipment for a lab.	III	4.06	4.18
14.	I am afraid that students will ask me questions that I cannot answer.***	IV	3.02	3.35
15.	Science is as important as the 3Rs.	II	4.14	4.35
16.	I enjoy manipulating science equipment.	I	3.49	3.97
17.	In the classroom, I fear science experiments won't turn out as expected.***	I	3.30	3.52
18.	Science would be one of my preferred subjects to teach, if given a choice.	IV	2.94	3.43
19.	I hope to be able to excite my students about science.	IV	4.41	4.56
20.	Teaching science takes too much effort.***	III	4.18	4.39
21.	Children are not curious about scientific matters.***	II	4.61	4.65
22.	I plan to integrate science into other subject areas.	II	4.04	4.22

*Scores based on a Likert-type scale, 1-5.
**I Science equipment, II Science need, III Time, IV Ease.
***Numerical values reversed.